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VOL. IV. NEW YORK, MARCH, 1899. No. 1

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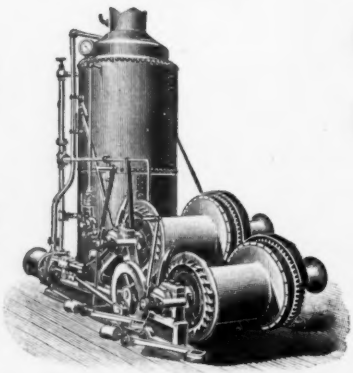

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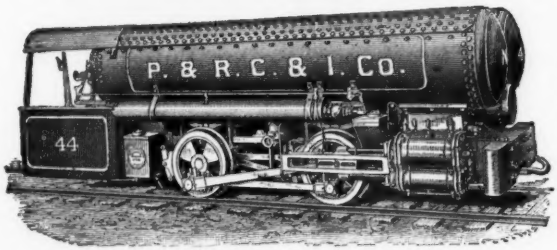

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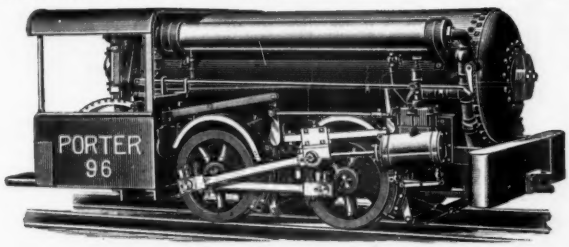

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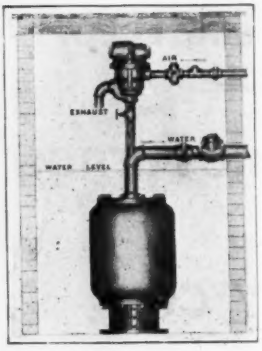

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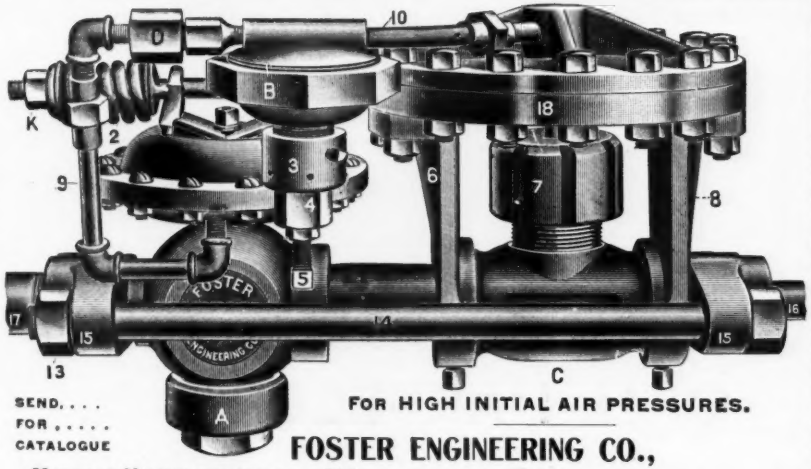

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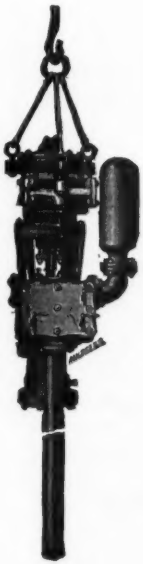

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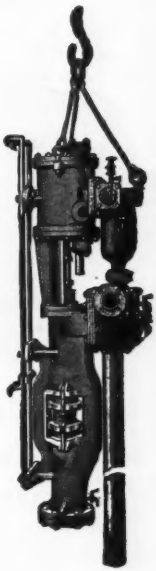

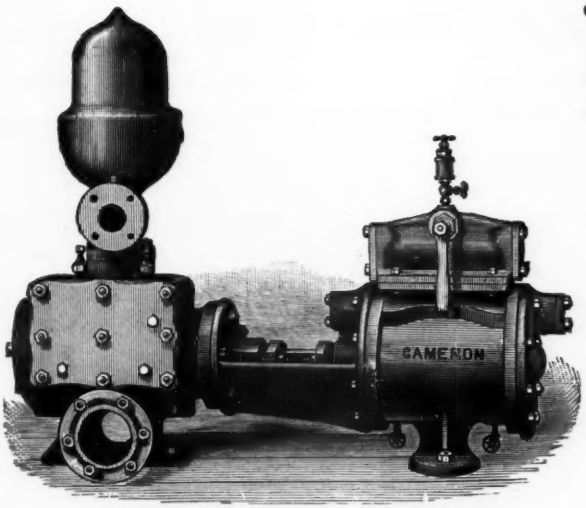

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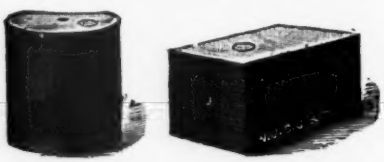

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Compressed Air.

A MONTHLY PUBLICATION DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

W. L. SAUNDERS, - - Editor and Proprietor
A. E. KENNEY, - - - - - Managing Editor
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A good deal has been written of late in the newspapers about the danger to which passengers may be subjected when riding in cars propelled by compressed air because of the storage of air under high pressure. Until recently experiments in the line of pneumatic traction were confined to air at moderate pressures, mainly because a safe bottle or receiver was not available. In designing a vessel in which to store the air it is necessary to consider the question of weight and as the air pressure was increased the weight of common receivers became so great as to be prohibitive. Pipes of wrought iron or steel were all right when made of extra thickness, but the weak point was in the cap or joint at the end of the pipe. During recent years there has been imported a weldless cold-drawn steel tube which has served the purpose very well. This tube is known as the Mannesman bottle and is made in Germany. Its safety lies in the fact that it is drawn from a solid billet of steel, hollow throughout with rounded ends forming a vessel of uniform strength and with no joints or welds of any kind. One end of the Mannesman bottle is tapped for a pipe of small diameter which connects with the interior and which serves as an outlet or inlet for the compressed air. This form of bottle is a safe vessel for air at pressures of 3000 pounds per square inch, and it is so designed that a number of these bottles, each about the length of the space under the seats of a street car, are laid side by side and connected at one end, thus storing enough air, as in the case of the Hardie car, to run approximately 25 miles.

Some experiments have been made with cold-drawn bottles made of nickel steel, which it is claimed will store air at 5000 lbs. pressure per square inch, and as the tensile strength of nickel steel is high, bottles made of this material should be able to safely carry large volumes of compressed air in a small space and without the handicap of serious weight. Now the safety of a steel bottle carrying compressed air is a simple question of engineering. A boiler carrying steam at a pressure of say 100 lbs. per square inch is less safe than an air bottle, because the boiler is composed of joints and rivets, and carries superheated water, all of which being subject to variations of temperature, thus increasing the uncertainty as to the factor of safety. The reserve force contained in superheated water in a boiler is enormous. Should a break occur and the steam be released this water is converted into steam almost instantly, and acts in a sense like gunpowder or dynamite producing destruction in its path. The air bottle is practically at all times subject to a uniform temperature. It is designed to stand a certain pressure and if properly tested before use and a factor of safety established beyond its working strains, there remains but little uncertainty or danger in its use. As a matter of fact these bottles are easily tested before use, and engineers agree that in a vessel of this kind it is not necessary to establish so great a factor of safety as with boilers or other vessels which are subjected to changes of temperature and more or less

varying strains. In a boiler, for instance, the feed water may run low and by sudden contact of cold water on hot plates the normal pressure may be momentarily very much increased. No such conditions can exist in the case of the steel bottle.

A better comparison with the air bottle is the strain upon a floor beam or the truss of a bridge. One might claim that a bridge is dangerous because it is subjected to hundreds or thousands of tons strain, yet this bridge when properly designed is intended to carry this strain and its strength of material is proportioned accordingly. It is customary in bridge construction to allow a wide margin or liberal factor of safety, because of vibration and other conditions which cannot be foreseen or estimated and which do not exist in the case of the air bottle. A cast iron column, even with a liberal factor of safety, is less likely to be safe than an air bottle, because blow holes may exist in cast iron beneath the surface, while with soft cold-drawn steel the material is uniform throughout. It should not be claimed, of course, that steel air bottles cannot be broken or that they are absolutely safe against explosions. Nothing in engineering is safe to a point of certainty, but it can safely be claimed that in the steel bottle the elements of uncertainty are small and easily controlled; that the bottles are not subject to deteriorating influences, as they are surrounded by free air on the outside and compressed air on the inside; that when made properly and carefully tested they may safely be used to carry air pressure strains of one-half the figures at which they are tested, and as it is quite possible to provide these vessels with blow-off valves they may be made practically safe.

Even though an air bottle should explode when carrying air at pressures of several thousand pounds to the square inch, it is not likely to be as destructive as is usually supposed. These bottles are arranged in a series in some respects like the water tube boiler, which is considered to be the safest form of boiler made. Water tube boilers do not explode. There have been instances where one or more of the tubes has been disrupted, but the effect is only local, while with common cylindrical boilers, explosions have been frequent and the results serious.

Air when released shrinks rapidly in volume, because of a rapid lowering of temperature. This tends to reduce the force of explosion. The effect would very likely be local and of very short duration, as the air once released is soon discharged.

Metering Compressed Air.

As the installation of compressed air Central Plants for distributing power is gaining daily in importance, the problem of measuring the amount of compressed air at certain pressures used by any consumer confronts not only the Central Plant owners but also the consumer. The consumer should know how much air he uses in order to know that he is charged reasonably for it, and the Central Plant owners must also know how much every consumer uses in order to avoid abuse and to ascertain whether the plant is operated on a paying basis.

Thus the Central Plant owners having a main supply pipe which may be branched off for distributing to mines or manufacturing establishments will find the necessity of installing meters and other apparatus which cannot be tampered with, and which at the end of each month will be able to give, not only themselves, but also the consumer proper data, from which the bills for the month can be figured.

The only way to properly determine the amount of compressed air used by any single consumer is to determine the amount of free air, which, if multiplied by the mean average pressure, will give the total amount of energy furnished.

The Equitable Meter Co. of Pittsburg has studied the problem of metering

compressed air for a number of years and are now manufacturing meters which we understand are giving very good satisfaction; as tests which have been made show that the readings vary but a very small percentage from the actual. Their standard size meters for compressed air, which we illustrate herewith, will carry a working pressure of 100 lbs. They have, however, made some high pressure meters for measuring compressed natural gas up

COMPRESSED AIR METER.

to 500 lbs. pressure. The meters are made in five sizes, as follows: 10, 20, 30, 40 and 50,000 cubic ft. maximum capacity per hour. The reader will, of course, understand that the amount of air passing through a meter during a certain time means the amount of air in cubic feet at the pressure at which it passes through the meter, no matter if the air pressure is 1 lb. or 100 lbs. to the square inch, and then to find the total volume of free air passed, the volume of compressed air will have to be reduced into a volume of free air.

We are also informed that there is very little pressure absorbed by the meter while the air passes through it, the pressure absorption being only about 1 oz., no matter what the air pressure is. These air meters are provided with a special back pressure relief valve, preventing the wrecking of the meter in case high pressure air would be let into the meter or taken out of it too suddenly.

The next question of importance to be considered is for both producer and consumer to know that the air pressure is as steady as possible, and sufficient to run the apparatus to be operated by compressed air, as there would be no use for a consumer to pay for a larger volume of compressed air at 50 lbs. pressure should he require 80 lbs. pressure, as a large quantity of air at a low pressure would not do his work; thus it would be necessary to install a compressed air Pressure Recording Gauge in connection with each meter, and at the end of the month the mean average pressure could be figured and this multiplied by the number of cubic feet of free air, the product representing the energy furnished, would enable both producer and consumer to settle upon the amount to be paid.

The problem has been explained clearly enough, but it may be added, however, that it would always be advisable to install a small receiver next to the meter and that the pressure recording gauge should be connected with this receiver; this, not only to avoid the vibration of recording finger, but also to prevent any shock to the meter.

It should be noted also that a consumer situated far away from the Central Power Plant should pay more per unit of energy than one near by, for the reason that the friction in long pipes amounts to a certain percentage of power, and that a long pipe line is more subject to leaks and requires more attention than a short one.

The reader will, of course, also understand that it is impossible to give an idea of the charge which should be made per unit of power, as the cost of producing compressed air varies considerably, according to localities, size of plant, whether plant is operated by steam or water power, whether, if operated by steam the engines are economical or not; but there is one thing certain, which is that if a Central Power Plant even be operated by steam and this plant would be of 1000 horse power, equipped with compound Corliss Engines, and would supply compressed air to, say five consumers, it should prove a great financial success, as it would save each consumer the installation of a small 200

horse power plant. These five 200-horse power plants costing much more by at least 30 per cent. and not being as economical by at least 60 per cent. as a first-class 1000-horse power plant.

In addition each consumer would require a fireman and engineer, while the Central Plant could be operated practically at the same expense for labor as a single 200-horse power plant.

Multipliers to be used for transforming volumes of Compressed Air at various pressures into corresponding volumes of Free Air at atmospheric pressure of 14.7 pounds.

PRESSURE IN POUNDS	MULTIPLIER	PRESSURE IN POUNDS	MULTIPLIER	PRESSURE IN POUNDS	MULTIPLIER	PRESSURE IN POUNDS	MULTIPLIER	PRESSURE IN POUNDS	MULTIPLIER
1	1.068027	26	2.768602	51	4.469377	76	6.170052	101	7.870727
2	1.136054	27	2.836729	52	4.537404	77	6.238079	102	7.938754
3	1.204081	28	2.904756	53	4.605431	78	6.306106	103	8.006781
4	1.272108	29	2.972783	54	4.673458	79	6.374133	104	8.074908
5	1.340135	30	3.040810	55	4.741485	80	6.442160	105	8.142835
6	1.408162	31	3.108837	56	4.809512	81	6.510187	106	8.210862
7	1.476189	32	3.176864	57	4.877539	82	6.578194	107	8.278889
8	1.544216	33	3.244891	58	4.945566	83	6.646241	108	8.346916
9	1.612243	34	3.312918	59	5.013593	84	6.714268	109	8.414943
10	1.680270	35	3.380945	60	5.081620	85	6.782295	110	8.482970
11	1.748297	36	3.448972	61	5.149647	86	6.850322		
12	1.816324	37	3.516999	62	5.217674	87	6 918349		
13	1.884351	38	3.585026	63	5.285701	88	6.986376		
14	1.952378	39	3.653053	64	5.353728	89	7.054403		
15	2.020405	40	3.721080	65	5.421755	90	7.122430		
16	2.088432	41	3.789107	66	5.489782	91	7.190457		
17	2.156459	42	3.857134	67	5 557809	92	7.258484		
18	2.224486	43	3.925161	68	5.625836	93	7.326511		
19	2.292513	44	3.993188	69	5.693863	94	7.394538		
20	2.360540	45	4.061215	70	5.761890	95	7 462565		
21	2.428567	46	4.129242	71	5.829917	96	7.530592		
22	2.496594	47	4.197269	72	5.897944	97	7.599619		
23	2.564621	48	4.265296	73	5.965971	98	7.666646		
24	2.632648	49	4.333323	74	6.033998	99	7.734673		
25	2.700675	50	4.401350	75	6.102025	100	7.802700		

Formula. $\frac{1}{14.7} \times \text{Pressure} + 1 = \text{Multiplier.}$

Atmospheric Pressure 14.7 pounds = 30″ Barometric Pressure. Temperature 60° Fahr.

To find the volume of free air at atmospheric pressure corresponding to a volume of air under pressure, multiply the amount of air under pressure by the multiplier corresponding to that pressure.

For each one-tenth of an inch difference in barometric pressure below 30 inches, first reduce the volume of compressed air into volume of free air at atmospheric pressure of 30 inches or 14.7 pounds, according to the table. Then use the following formula:

$$V^1 = \frac{300}{300-X} V$$

in which V^1 represents the volume of free air at reduced atmospheric pressure; V the volume of free air at atmospheric pressure of 14.7 pounds, and X the decrease in one-tenth of an inch barometric pressure below 30 inches.

For each 5 degrees difference in temperature between end of pipe line and compressor, add or subtract, according to increased or decreased temperature, one per cent. to volume of free air.

Examples: Assume that we have 320 cubic feet of air at 90 pounds pressure, the atmospheric pressure being 14.7 pounds and temperature 60 degrees, both at receiver and end of line. In looking over table of multipliers we find that the multiplier for 90 pounds is 7.12243. Thus the amount of free air would be $320 \times 7.12243 = 2279$ cubic feet of free air at 14.7 pounds.

Suppose now that this would apply to Leadville, Col., where the barometric pressure is 20.4 inches. The volume of free air at that pressure would then be as per formula above.

$$2279 \times \frac{300}{300-96} = 3351 \text{ cubic feet.}$$

Assume now the temperature in receiver to be 60 degrees and that the air would be re-heated to 155 degrees, the volume of free air at 155 degrees and 20.4 inches barometric pressure corresponding to above volume of compressed air would be

$$3351 \times \left(1 + \frac{19}{100}\right) = 3987 \text{ cubic feet of free air at } 155^\circ \text{ and } 20.4 \text{ in. barometric pressure,}$$

in which 19 represents the increase of volume of one per cent. for each 5 degrees increase in temperature.

The reverse can be done in order to determine the volume of compressed air at various pressures, when the volume of free air, barometric pressure, temperature of free air, temperature of compressed air and terminal pressure are known. This is effected by transforming the multipliers into dividers. Example: What will be the amount of compressed air obtained from 4000 cubic feet of free air at 60 degrees receiver temperature with initial barometric pressure of 20.4 inches, initial temperature of 40 degrees and terminal pressure 90 pounds gauge? We first reduce the volume to 30 inches barometric pressure, and have

$$V = V^1 \times \frac{300-X}{300} = 4000 \times \frac{300-96}{300} = 2720$$

cubic feet of free air at 14.7 pounds and 40 degrees. At 90 pounds and 40 degrees we divide the amount by the multiplier corresponding for 90 pounds, and have

$$\frac{2720}{7.12243} = 382 \text{ cubic feet.}$$

For an increase of temperature of 20 degrees we will have an increase of volume of one per cent. for each 5 degrees; thus the total amount would be $382 \times 1.04 = 397$ cubic feet of compressed air at 90 pounds gauge pressure and 60° temperature.

F. SCHMERBER.

Improved Pneumatic Displacement Pumps.

The application of air pressure directly upon liquids contained in submerged receptacles of suitable design as a method of pumping, is old and well known to Pneumatic Engineers as the "Displacement System."

While from a theoretical standpoint the efficiency of the "Displacement System" is low, its adaptability, by which existing economical sources of power may be utilized for the production of the required air pressure, irrespective of the relative location of the source from which the water is taken, the low cost of installation when compared with an isolated pumping plant of the usual type, and the remarkable low cost of maintenance more than offsets the low efficiency and renders the system desirable and applicable to many cases.

The displacement types of pneumatic pumps shown by the accompanying illustrations, embody recent improvements upon the construction formerly brought out by

the writer, many of which, installed during the past five years, pumping water under favorable conditions, are giving entire satisfaction to the purchasers.

These early patterns consisted of one or more iron chambers adapted to be submerged in the liquid pumped, having liquid ingress and egress openings closed by suitable valves, and an air valve for controlling the supply and release of air pressure to and from the submerged chamber.

The air valve was placed in the chamber or directly on top, below the water level, or outside of the chamber above the water

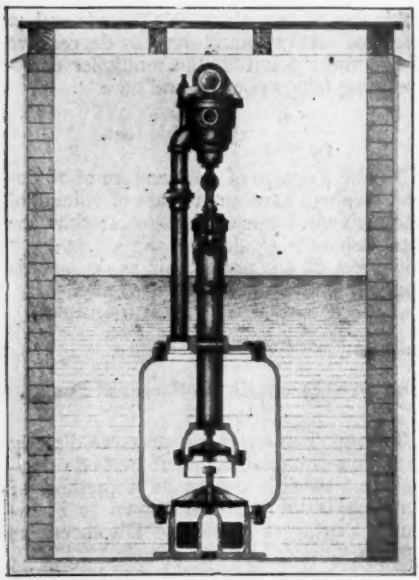


FIG. 1.

level. In all cases the movement of the air valve was controlled by floats, within the water chamber, arranged to actuate the air valve directly, or connected with supplemental valves which governed the main valve.

The mechanical difficulties encountered with these early constructions, and the objections thereto are chiefly as follows:

FIRST—The limited available actuating power of all kinds of floats suitable to be contained within the water chamber, rendering the pump inoperative if the air valves become clogged or stick.

SECOND.—The very great tendency of closed floats to collapse or fill with water under high pressure. With open end floats, the excessive loss of air required to displace the water which enters the mouth of the open end float, until the air entrapped therein corresponds to the external working pressure.

THIRD.—The possible disarrangement of the floats, or air valve mechanism, from

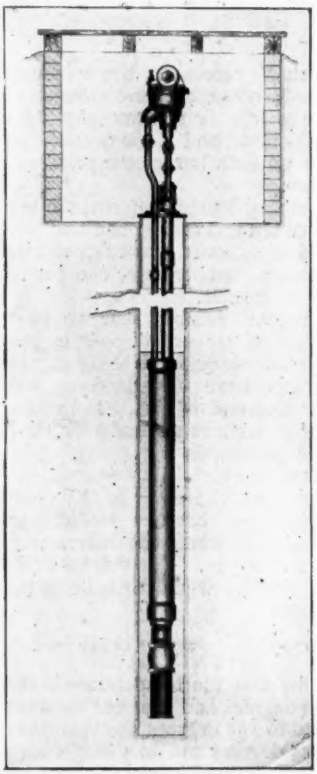


FIG. 2.

the rapid influx or efflux of water. The injurious elements—sand, mud or sediment, and the chemical action of the water which causes the air valves to leak and stick.

FOURTH.—The inaccessibility of the working parts, requiring the removal of the entire pump to make repairs of however slight a nature.

The improvements embodied in the writer's new type of displacement pumps

consist mainly, of the entire elimination of floats, the removal of all valve-actuating mechanism from the water chamber, and the placing of a self-contained air valve above the water level, thereby avoiding the difficulties mentioned.

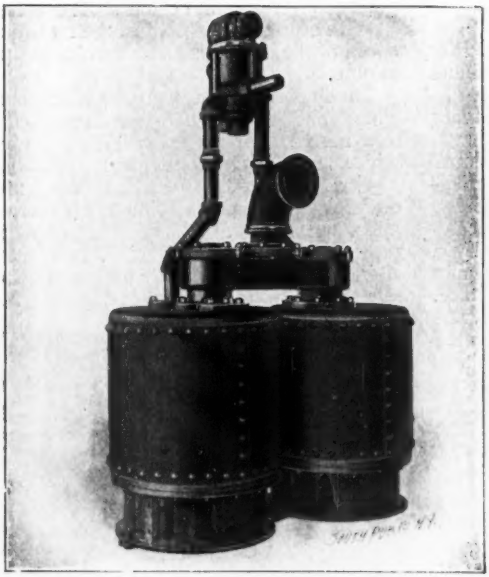


FIG. 3.

Figure 1, is a sectional view through the chamber of a single-acting type of the improved pump, showing the water admission and discharge valves, and the absence of all other moving parts below the water level.

The automatic air valve which is the subject matter of U. S. Patent No. 609943, August 30th, 1898, consists of a main air valve controlled by an auxiliary valve, both of which are driven by differentiated pistons on which the air pressure is applied. By this means the valve motion is prevented from hanging up in a central position.

The movement of the air valve is predetermined and adjusted to the maximum filling capacity of the water chamber, which is so proportioned as to exceed the discharge capacity, thereby insuring complete filling of water chambers.

Pliable cup packings held out by brass tension rings are used on the piston valves to prevent air leaking. These cup packings, working in composition cylinder linings, are subject only to the action of compressed air, from which sufficient lubrication is obtained by the oil taken up during compression of the air.

In practice it has been found that these cup packings are exceedingly durable, wearing for several years and remaining pressure-tight. Being accessible they are easily and cheaply renewed if necessary.

The automatic air valve may be placed just above the water level or any distance away from the water chambers, as shown by the bored well displacement type (Fig. 2). It is preferable, however, to place the air valve near the water level to avoid the loss of air required to fill the connecting air pipes above. When the water chamber is nominally submerged the velocity of influx will carry the water in the air pipes some distance above the water level, and to a still greater height by an increased submergence. With the bored well displacement type (Fig. 2), there is usually sufficient sub-

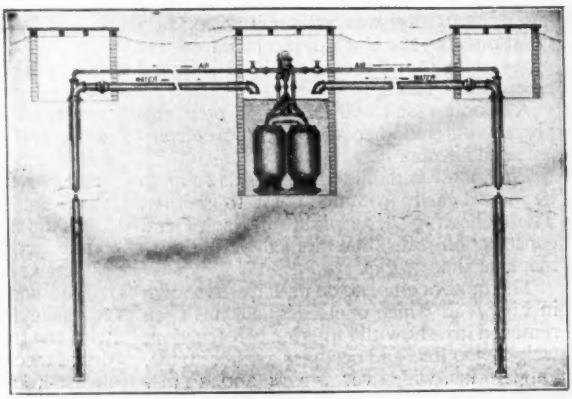


FIG. 4.

mergence to reduce the clearance loss very materially.

The water chambers are made in various forms and sizes to conform to the conditions of the sources or wells from which the water is taken.

The single-acting types are adapted for moderate service up to 50 gal. per minute capacity.

For heavier service the duplex types [Fig. 3] are recommended.

Figure 4 represents a "combination plant" pumping from one or more wells by modified types of the well known "Pohle Air Lift," discharging therefrom into a receiving well at the surface, from thence by a "Duplex Displacement Pump" to any desired point of delivery above the surface.

With this combination water may be effectively delivered at distant elevated points, by a single Air Compressing plant, from bored wells having a submergence only sufficient for the economical operation of the "Air Lift" in discharging at the surface.

These pumps are manufactured by the Merrill Pneumatic Pump Co., 141 Broadway, New York. F. H. MERRILL.

Portable Motor.

The development of the Stow Flexible Shaft affords an interesting example of the progress of the age of mechanics. It is used to operate drilling, tapping, reaming and grinding tools for portable work.

It has gone through the experience of "rope drive" from any convenient shaft. Then electricity was adapted with fairly good results—the chief objections were expense, danger and the necessity of a skilled mechanic to run it.

A Compressed Air Motor is now employed and embodies the required convenience and economy.

The motor is mounted on wheels so as to be moved easily from one point to another. The following description of its general construction will show its adaptability to machine shop works.

The motor complete on its base, as shown in Fig. 1, in which one side-plate has been removed to show the interior construction, weighs 300 lbs., and occupies a space 20 ins. long, 18 ins. wide over wheels and 19 ins. high. With an air pressure of 80 lbs. it is capable of developing 8 horse power. It is provided with a 6-in. pulley (P) on one end of the shaft, while at the other end is a projecting counter-shaft capable of running at two speeds, and on which can be slipped a patent universal joint flexible shaft coupling.

With a pressure of 80 lbs. the maximum speed of the engine is 1,400 revolutions per minute.

The construction of the motor is extremely simple, and consists of a substantial cast-iron base plate 20 × 14 ins., Fig. 3, upon which, in a water and dust tight box, 12⅜ × 7⅛ × 13 7-16 ins., are two small oscillating cylinders, having a diameter of 3 ins. and a stroke of 3 ins. The two piston rods connect directly to a solid forged shaft, 1¼ ins. in diameter, which has three good-sized bearings, two in the end plates, and

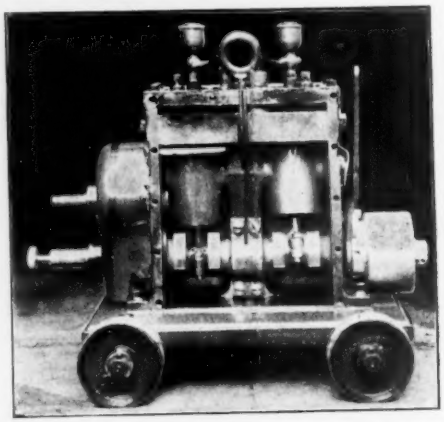


FIG. 1. PORTABLE MOTOR.

one in the center column, which is cast with the bed plate. This column also contains the inner trunnion bearings for the cylinders, and into its top is screwed a heavy lifting ring, which is used to support the motor over the work when desired, or it can be used to transport the motor about the shop if there is a traveling crane. The outer trunnion bearings are in the end plates, as will be seen in both figures.

The back of the cylinders, corresponding to the cylinder head, is turned concentric with the trunnion to present a convex cylindrical face to the valve block (B), which is a cast-iron block with a concave cylindrical face corresponding to the outer ends of the cylinders and containing properly-spaced

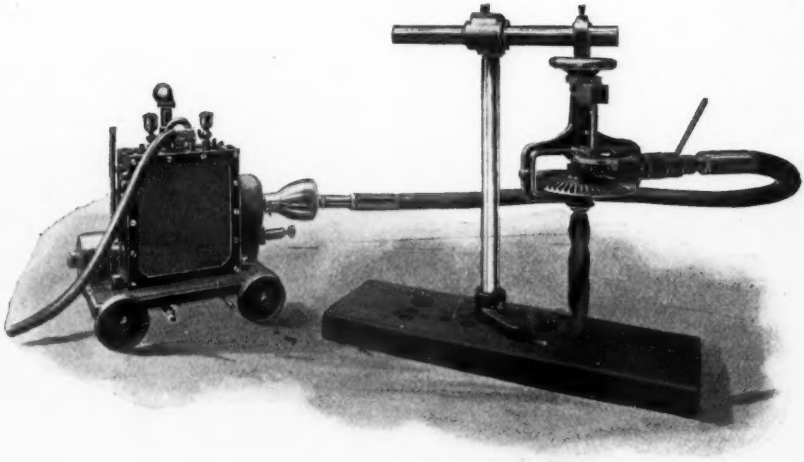


FIG. 2. STOW FLEXIBLE SHAFT AND MOTOR.

inlet (S) and exhaust ports (E). This valve block is held in place against the cylinder ends by suitable springs and adjustment screws. The gear case (G) at the end opposite the pulley contains two pairs of gears, a 2-in. and a 5¾-in., and a 2¾-in. and a

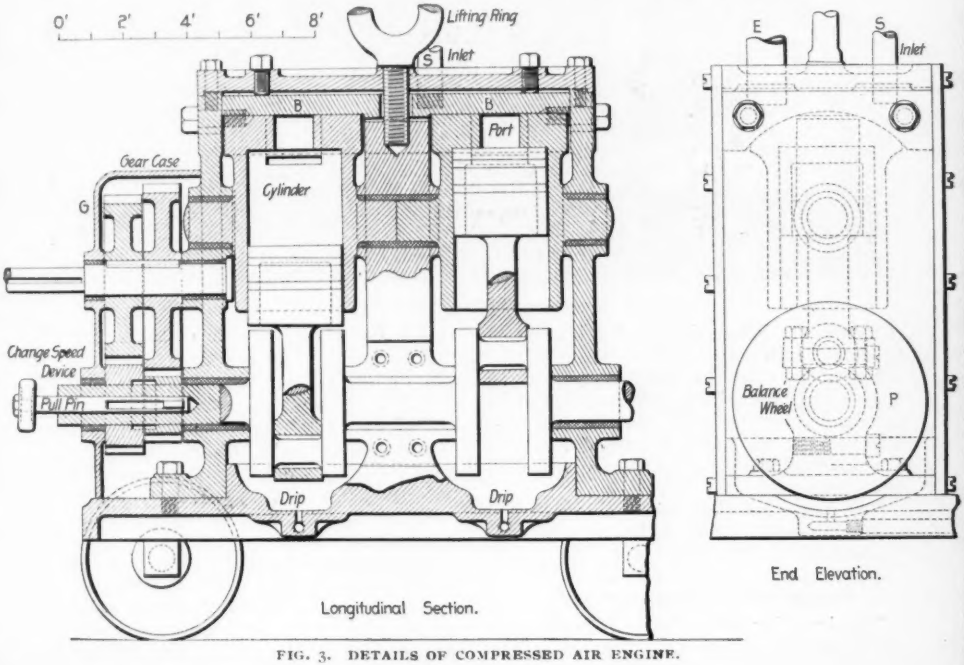


FIG. 3. DETAILS OF COMPRESSED AIR ENGINE.

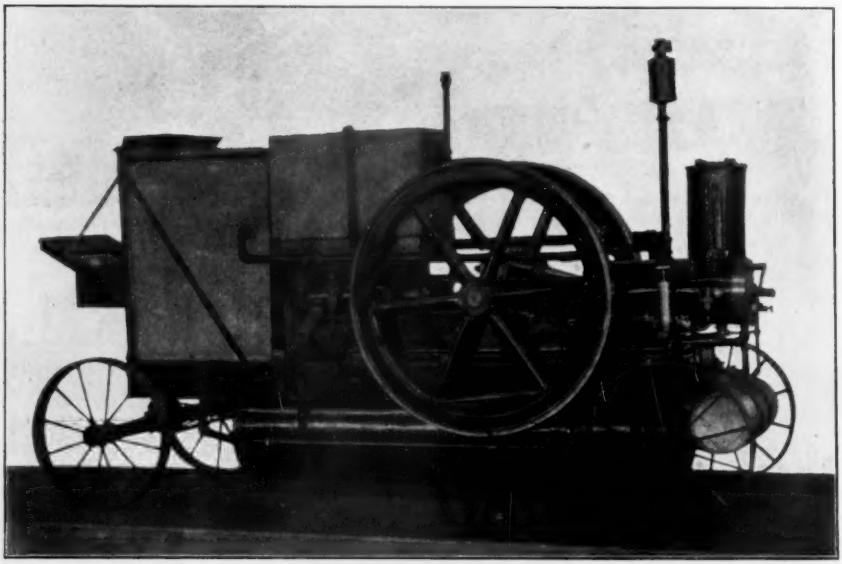
5-in. The smaller gears are mounted upon the engine shaft, which is hollow at the end and contains a slip key, provided to lock either gear to the engine-shaft. The larger gears are firmly keyed to a short counter-shaft, from which power to operate the flexible shaft is taken. At the maximum speed of 1,400 revolutions per minute, there are, therefore, two shaft speeds, 485, 773, according to the pair of gears in operation, which is controlled by simply pushing in or pulling out the slip key. Any other speed can be obtained by throttling the air supply, with, however, a corresponding reduction in power. While designed primarily to operate flexible shafts, the motor is also arranged to take the place of any small engine, and the driving pulley admits of its use for a variety of purposes; for example, it can be placed near and belted directly to a polishing machine, an emery grinder, brass lathe, etc.

The motor is being built and introduced by the Stow Flexible Shaft Co., 26th and Callowhill Sts., Philadelphia, Pa.

Portable Air Compressing Outfit.

The long felt want for a compact and serviceable Mounted Air Compressor has been lately supplied in a neat design, by Fairbanks, Morse & Company, of Chicago, as shown in the cut herewith.

The machine consists of one of their Combined Gasoline Air Compressors, mounted complete on a truck, making a portable outfit which can be easily drawn about. It is supplied with two square water tanks; one for cooling the engine cylinder and the other for cooling the air cylinder. The air receiver tank is located under truck and connected to compressor with unloading valve interposed, thus maintaining a steady and uniform pressure. The gasoline tank is suspended at back of truck and under cylinder. The engine is fitted with a silencer for exhaust, is equipped with both electric and torch ignitors, and is all connected up ready to run.



PORTABLE AIR COMPRESSOR.

The compressor illustrated herewith was built for the Cleveland Ship Building Company, to be used in connection with pneumatic riveting tools in the construction and repairing of vessels.

It will be noticed that the machine is self-contained on one iron frame, and the pistons of the power cylinder and the air cylinder are connected by distance rods. In this way one crank and connecting rod serves

for the operating of both power and air pistons.

The machine has a capacity of 70 cubic feet at 80 pounds pressure. Gasoline is used for fuel and as the engine is of about 12 horse power, the machine if kept to its full load would consume approximately twelve gallons of gasoline for a run of ten hours.

The engine is equipped with an automatic governor which feeds fuel in proportion to the amount of work supplied, which in this case would be the quantity of air delivered.

The air end is fitted with an automatic unloading valve. This valve controls the pressure, keeping it to a given point. When the amount of air used is less than that delivered, the unloading valve comes into action, and the air cylinder is cut out, thus relieving the load upon the engine, and by this fuel is saved.

Mail Tubes in times of a Blizzard.

THEY SAVED THE LOCAL SERVICE, BEING INDEPENDENT OF SNOWDRIFTS.

One of the worst snow storms that ever visited the Eastern States was experienced during Feb'y 12th, 13th and 14th. Steam, electric and ordinary traffic were suspended, and the New York *Sun* makes the following report on the Compressed Air system of transmitting mail:

"The storm did not cause half the delay in the local mail service that many smaller storms have caused, and Assistant Postmaster Morgan declared yesterday that it was the pneumatic mail tubes that saved the service. The tubes run from the main Post Office to the Produce Exchange, from the main office to the Grand Central Palace and from the main office to the General Post Office in Brooklyn. The Forty-second street line has a number of branch lines that connect with branch stations between the General Post Office and the Grand Central Palace. The tubes being under ground, of course, unusual conditions on the surface do not affect them, and since the changes that have been made in their management and operation they have done remarkably good service.

It has always been New York's experience in a storm that tied up the street traffic to have the mail service tied up, too. The big wagons could not get around in the storm to collect the mail from the stations and things simply had to wait until the conditions were improved. This has caused untold inconvenience and trouble and in some cases loss to business people. The Assistant Postmaster said yesterday when he was asked about the condition of the city service:

"There has been little or no delay in our city delivery, and this has been largely due to the effectiveness of the pneumatic tube service. The mail wagon service was seriously hampered and for long distances was rendered practically useless by the snow. But the tubes did their work on time and most of the downtown and uptown mail went through them. They were especially serviceable in delivering the mails to what is called the Wall street section of the city. Brooklyn and the upper section of Manhattan borough also profited from the fact that the snow could not block the tubes. They certainly have proved to be an especially valuable adjunct to the postal service in weather like this, and have enabled us to deliver large quantities of mail, which, under the old mail wagon system, would have stalled in the main office here."

The Assistant Postmaster explained that the tubes carried nearly all the first-class letter mail between the stations they connected, and that in the delivery of special delivery letters, particularly, there was scarcely any noticeable delay. It took the messengers who carried these letters after they reached the offices a little longer to get around, of course, but that was all. Some of the Post Office folks and some of the employees of the Despatch Company, which owns the tubes, declared that all during the storm the Post Office beat the telegraph companies when they came into competition, and that letters when they bore the 10 cent special delivery stamps, reached their destination ahead of telegraph messages sent at the same time.

The delay in the mail service was confined entirely to the out-of-town service and the service in that part of the city where the tubes do not reach. But the service in those parts of the city was better than usual, too, for the effective work of the tubes made it possible for the postal authorities to withdraw some of the wagons used on the tube route and send them to the unsupplied districts to help out."

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz., all communications should be written on one side of the paper only; they should be short and to the point.

Editor of "Compressed Air":

Could you give me any information about water getting in the air of a compressed air pipe line? We drain our receiver every three or four days, but do not get any water to speak of. The air is piped about 300 feet.

Wilkesbarre, Pa. T. R. H.

To thoroughly deposit the moisture from the air of your compressed air pipe line before it leaves the receiver, you will find it necessary to cool the air in the receiver to at least a temperature of the surrounding atmosphere. A simple illustration of why this is so would be the falling of dew during still evenings in the warmer seasons; during the day the air becomes heated and at all times has more or less moisture in it; during the evening this same air becomes cooled to what is known as the dew point and the moisture is condensed and deposited as dew. To apply this to compressed air: the air becomes heated during compression and the moisture is held in a form of vapor; if the air is cooled before leaving the receiver this moisture will be condensed and deposited there in an amount directly proportional to the lowering f temperature. If you desire to avoid all water in the pipe line, you should cool the air in the receiver lower than the temperature of any surface it may come in contact with in passing along the line.

In laying a compressed air pipe line it is highly advisable to select the coolest possible position for a receiver, say where it is shaded and the wind can pass around it or when water is at hand emerse it. By putting additional receivers into the line and so locating and constructing them as to cool the air below its initial temperature, you will be able to overcome your difficulty.

An editorial in the November, 1898, issue of "Compressed Air" [page 521] describes the cooling system in the Anaconda Copper Mines, where numerous receivers in the form of old boilers are used with a success.

Compressing air by the Compound system makes the discharge into the receiver at a much lower temperature than in single stage compression. This would also help you to overcome your difficulty.

St. Paul, Minn., Jan. 16, '99.

Editor of "Compressed Air":

Page 433 of "Compressed Air," in an article on "Liquid Air," reference is made to Prof. Dewar's table of the density of some gases at a temperature of 15° Centigrade, and at a pressure of 3000 atmospheres per square inch.

Will you please have the kindness to explain how these very high pressures are obtained, and what materials are used for this purpose.

Thanking you in advance for your information, and always thankful for the useful information to be found in your "Compressed Air." FREDERICK THEDE.

Such pressures as 3000 atmospheres pressure per square inch could be obtained by multiple or stage compression, just the same as 3000 lbs. per square inch is obtained, only the compressor would need to be of special construction to suit that high pressure. Or it could be obtained by compressing the gas, say to 5000 lbs. pressure per square inch, and then connect the storage tube or flask to hydraulic pump and pump in water until the gas had been compressed to required pressure. Either steel or bronze tubes or flasks made the proper thickness of wall to withstand such pressures would answer perfectly well. Care should be taken, though, that the metal is of dense enough grain to prevent escape of gas through metal itself.

"Compressed Air": Halsey, Ky., 2-24-'99.

Enclosed please find money order subscription to "Compressed Air" for one year.

You say your Journal is devoted to the useful applications of compressed air. Why could not compressed air be applied to

blacksmith's forges? It seems that a plant might be established in a city where there are forty or fifty blacksmith shops and the air piped to them, thus doing away with the bellows, and, in many shops where light work is done, the helper as well; or at any rate the helper could do something else besides pumping a bellows, and the proprietor would pay for the amount of air he got. Also pipes might be carried into any tailor or dressmaking shops on the line and by means of a tiny engine run the sewing machines for them.

In discussing the project with a friend here, it was objected that the air holds too much water for a blacksmith's forge. Could not perfectly dry air be delivered anywhere by passing the current over quick lime? Please answer in "Compressed Air."

N. LAFON.

When you have read "Compressed Air" for one year you will find what common practice it is to operate blacksmith's forges by compressed air. It was used for that purpose in the year 1640, and going back further the bellows may be considered as the earliest air compressor. Your friend's objection will not hold good (moisture in compressed air is only a relative term depending upon temperature); nearly every railroad and machine shop using compressed air applies it to blacksmith's forges with good results.

In Paris they use it to operate sewing machines, and it would be a boon to civilization if it were used in the larger cities of this country. At the present time the tailoring shops of New York are undergoing investigation. Large numbers of operatives are packed in small quarters and work many hours each day to eke out an existence, the greater part of which is spent in these sweat-shops inhaling vitiated air and the exhalations thrown off by the human beings thus circumstanced.

Compressed air used for operating the machines in these places would be of incalculable benefit to those who must earn their livelihood by such means. What could be more desirable than taking from the pure atmosphere, God's free air, compressing it, thereby killing any invidious germ that might by accident be in it, and distribute it through the exhaust of the motor to the army of people who are located in these awful holes.

Your questions bring us back to the much mooted subject, "A public supply of Compressed Air," and this will be accomplished when the demands and the increased applications of compressed air hold out inducements enough for capital to invest with some show of profitable returns.

Duluth, Minn., Jan. 26th, 1899.

Editor "Compressed Air":

For the benefit of myself and other readers will you please say in your next issue, why, if compressed air is used in transmission of mail for limited distances in New York and Philadelphia, it cannot be used in like manner, over long distances, say for instance to transport mail from one to the other of above named points.

Yours truly,

D. M. PHILBIN.

The use of compressed air for the transmission of mail and parcels is not limited as to distance, and such a system could be constructed between New York and Philadelphia, but there are many things to be taken into consideration as to whether such a system would be of commercial value.

First: Let us consider whether there would be any advantages in speed between the two points. An express train on the Pennsylvania Railroad covers the distance between Jersey City and Philadelphia (90 miles) in about one hour and forty minutes. The rate with which pneumatic tube carriers travel in the present system in New York City is at the rate of a mile in a minute and a half. Consequently the saving of time—supposing that a carrier and a train were dispatched at the same time—would be in favor of the train, but there is this advantage in regard to pneumatic tube that the carriers could be dispatched at very short intervals, whereas mail carried upon trains has to wait the scheduled departure thereof.

If a line of such length were constructed without relay pumping stations, all the compressing being done from the terminals, the initial pressure and necessary volume of air would be tremendous, and this alone would make the cost so great that it would be out of the question.

What may be accomplished some day is a system constructed from New York to Jersey City; from Jersey City to Newark; from Newark to Elizabeth; from Elizabeth to Rahway; from Rahway to New Brunswick; from New Brunswick to Princeton Junction; from Princeton to Trenton; and so on with stops at principal stations to Philadelphia. But in this case, each line between cities would be an individual system with terminals together so that a carrier dispatched for Newark could contain mail for say two stations beyond, but as for a pneumatic tube line between Philadelphia and New York, it is believed that the railroads are superior for this sort of transportation.

The pneumatic tube system has accomplished marvelous results in crowded cities where mail had to be formerly carried by wagons or trolley cars. This is the field for pneumatic tubes, and it is only a question of a few years before railroad mails coming into cities at the rate of 45 miles an hour will not be carried thence to the Post-Office at the rate of 4 miles an hour by the antiquated wagon, but by pneumatic tubes at the same rate of speed that they came into the city by express trains.

Editor "Compressed Air":

A copy of your monthly publication has been given me lately; being interested in pneumatic appliances, but more especially in its use for steering vessels. It has been tried and approved of for ten years past, but has not come into universal recognition for this purpose yet. While formerly tried on a U. S. vessel and a coast steamer with success, its last application is in the U. S. Monitor Terror, which did some good work during the late war, and proved effective, with many other uses to which it was put on board, but more especially in its use for steering. The slow progress in its adoption has come from other systems more strongly backed, and owing to too much red tape at Washington. Senator Chandler, on Dec. 6th, 1898, brought the subject forward in a resolution, asking why the pneumatic system is so overlooked, when it has proved so effective. It is gaining ground every day for everything, here and abroad.

The Scientific American of March 20th, 1897, and March 7th, 1898, has an article on the pneumatic system on the U. S. Monitor Terror, with illustrations. To corroborate what I write, I can refer you to many reports of the Navy Department and others, endorsing the system for the Navy.

The elevated road has talked of using compressed air, but there is a pressure to have electricity adopted.

I have been much interested in Mr. R. P. Whitelaw's article you publish.

JOSEPH C. WALCOTT.

Stamford, Conn., Feb. 20th, 1899.

PATENTS GRANTED JAN., 1899.

618,242.—Hydraulic Air Compressor. A. A. E. Sterzing, New York.

This invention consists of a series of injectors, operatively connected and each provided with inlets and outlets for air and water, a chamber being provided for receiving the discharge from the ports, having independent outlets for the air and water. The injector inlets are telescopically arranged, and terminate in concentrically-disposed annular ports, having a deflector adjacent thereto, means being provided for adjusting the inlets so as to vary the area of the ports.

618,243.—Hydraulic Air Compressor. C. H. Taylor, Montreal, Canada.

A chamber, wherein the air and water are separated, is provided with a blow-off device or conductor, having a valve adapted to prevent the escape of air into the return column of water. The casing of this valve is formed with an outlet and inlet. A sleeve projects into the latter having a piston therein, while a weighted lever, fulcrumed to the casing, is connected to the piston, thereby closing the valve when the pressure falls below a certain limit, thus preventing outflow through the conductor. To maintain the even flow of water, the walls of the chamber are provided with deflector-plates.

618,204.—Air Brake. E. A. Hauerwas, Saratoga Springs N. Y.

This is an automatic air-brake having a brake-cylinder, a retaining-valve, and an escape valve adapted to be closed by overpressure located between the cylinder and valve. The escape valve consists of a cylinder having an end port and an inwardly projecting flange. Its piston is formed with a notch in its periphery, while a spring tends to hold the valve open until overcome by an excess of pressure.

616,997.—Air Purifying and Ventilating System. W. S. Whitney, Glens Falls, N. Y.

A reservoir containing water is provided with an outlet above the level of the water, while an air-supply-pipe extends below the level. When the air is introduced through this pipe into the water it is forced upward to the outlet by means of a centrifugal air-ejector.

618,615.—Air Moistener and Attemperator. W. H. Prinz, Austin, Illinois.

A plurality of compartments, having air circulating therethrough, are divided by perforated screens, the latter being kept moist by means of spray-nozzles. Other nozzles, below the first-mentioned ones, are connected with sources of water and air-supply under pressure, that of the air being in excess. The water is thus atomized to permit of its ready absorption by the air passing through the apparatus.

ALPHABETICAL LIST OF PNEUMATIC INVENTIONS.

For which United States patents have been granted. Prepared for COMPRESSED AIR from official records by GRAFTON L. MCGILL.

APPLIANCE.	NAME OF INVENTOR.	DATE OF ISSUE.	NO.
Air Brake	Newton	April 16, 1878	202,368
"	Norris	Oct. 22, 1889	413,205
"	Noyes	Jan. 28, 1896	553,565
"	"	July 21, 1896	564,389
"	"	Nov. 10, 1896	571,095
"	"	Nov. 24, 1896	571,786
"	"	Feb. 22, 1898	599,348
"	"	Feb. 22, 1898	599,349
"	Nellis et al.	Nov. 23, 1897	594,033
"	Nef	April 12, 1898	602,094
"	Osgood	March 4, 1879	212,972
"	O'Hara	May 8, 1894	519,681
"	Omick	July 7, 1896	563,612
"	"	August 24, 1897	588,913
"	Olin	Feb. 8, 1898	598,678
"	Perrine	August 3, 1875	166,404
"	"	August 3, 1875	166,405
"	"	August 3, 1875	166,406
"	"	Nov. 2, 1875	169,575
"	Prince	June 18, 1878	204,914
"	Paradise	Feb. 19, 1884	293,774
"	Perkins	July 13, 1886	345,537
"	"	Feb. 8, 1898	598,887
"	Pickering	Jan. 19, 1886	334,466
"	Park	June 26, 1888	385,198
"	"	Dec. 4, 1888	393,784
"	"	July 23, 1889	407,445
"	"	June 9, 1896	561,811
"	"	June 21, 1898	605,904
"	"	June 21, 1898	605,905
"	Pritchard	Sept. 10, 1889	410,922
"	Pritchard et al.	March 5, 1889	399,158
"	" et al.	March 5, 1889	399,157
"	Pelton	Sept. 13, 1892	482,382
"	Parke et al.	Oct. 3, 1893	506,185
"	Pinkston	July 11, 1893	501,359
"	Pool et al.	June 13, 1893	499,582
"	Pettengell	Jan. 11, 1898	597,220
"	Reniff	Oct. 10, 1876	183,206
"	Raoul	May 14, 1878	203,647
"	Reilly	Dec. 18, 1883	290,269
"	Rymer	Dec. 10, 1889	416,953
"	Roberts	July 29, 1890	433,040
"	Robinson	Oct. 7, 1890	437,800
"	Riggs	August 4, 1891	457,215
"	Rothschild	Feb. 27, 1894	515,616
"	"	Feb. 27, 1894	515,617
"	Richardson	Jan. 23, 1894	513,145
"	Reyburn	Oct. 6, 1896	568,923
"	Rogers et al.	Jan. 21, 1896	553,294
"	Redfern	June 15, 1897	584,705
"	Steger	August 11, 1874	.....
"	Stevens	May 29, 1877	191,261

ALPHABETICAL LIST OF PNEUMATIC INVENTIONS.—*Cont.*

Appliance.	Name of Inventor.	Date of Issue.	No.
Air Brake	Schultz	Sept. 30, 1879	220,178
"	Sjogren	June 17, 1884	300,401
"	Sloan	Oct. 28, 1884	307,344
"	"	Sept. 29, 1885	327,027
"	"	Nov. 10, 1885	330,164
"	Solano	Jan. 24, 1888	376,970
"	"	Feb. 28, 1888	378,628
"	"	May 8, 1888	382,667
"	"	July 31, 1888	387,018
"	"	June 25, 1889	405,855
"	"	June 25, 1889	406,006
"	Stewart	Jan. 28, 1890	420,121
"	Schroyer	April 22, 1890	426,144
"	Slater	May 26, 1891	452,942
"	Shortt	Feb. 16, 1892	469,176
"	Silcock	Feb. 9, 1892	468,701

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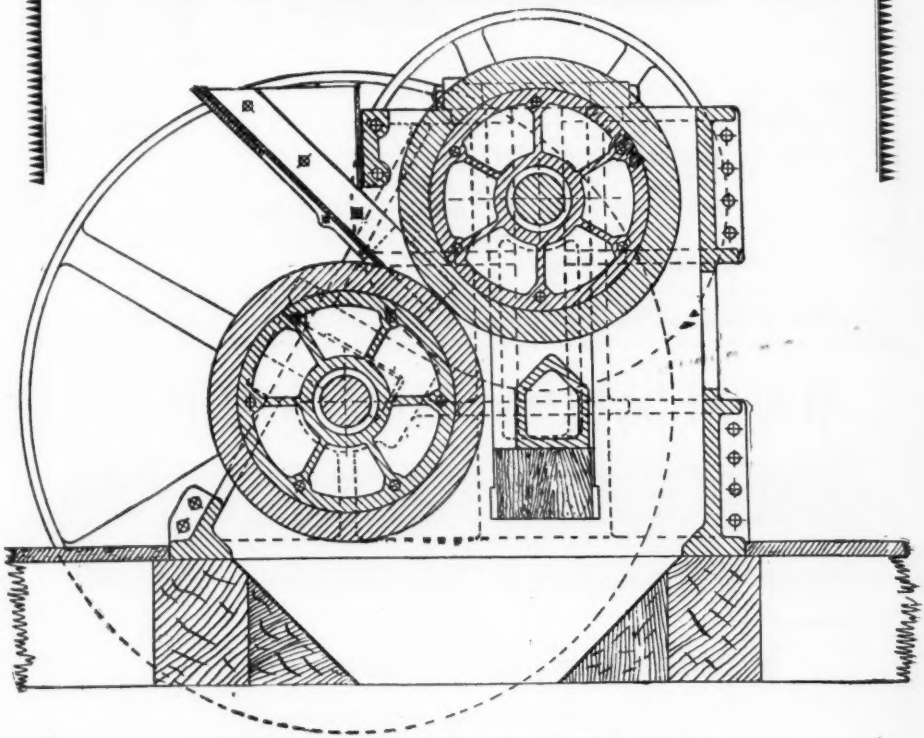

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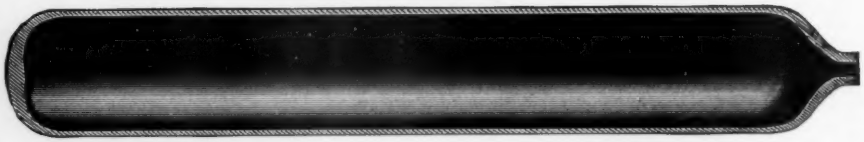

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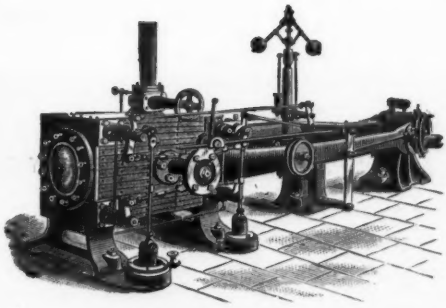

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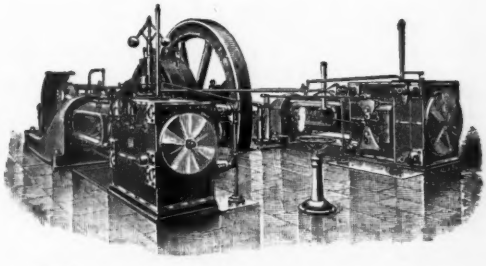

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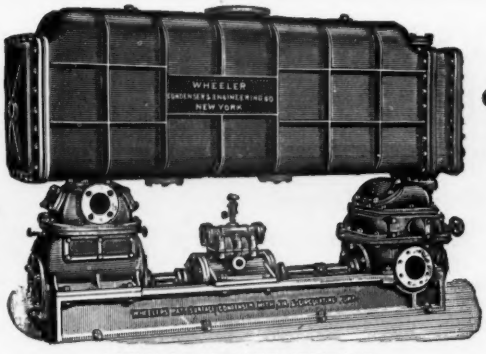

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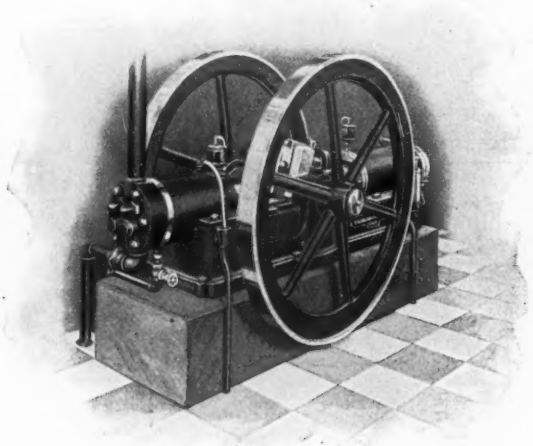

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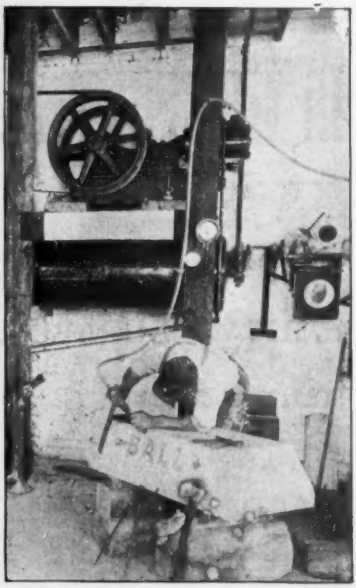

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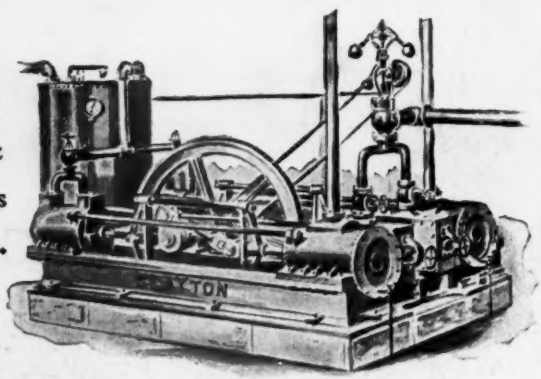

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